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Job No. 22192
Written Response Required: YES
Due Date: June 3, 2002
Actionee: K.A Klein
Closes CCN: N/A
OU: 202S
TSD: N/A
ERA: N/A
Subject Code: 2020

MAR 29 2002

U.S. Department of Energy
Richland Operations Office
K. A. Klein, Manager
P.O. Box 550, MSIN S7-41
Richland, Washington 99352

Subject: **ELIMINATION OF ADMINISTRATIVE TECHNICAL SAFETY REQUIREMENTS ON 276-S-141 and 276-S-142 HEXONE TANKS IN THE REDUCTION OXIDATION (REDOX) FACILITY**

Reference(s):

1) Letter, B. Wilson, Ecology, to P. M. Knollmeyer, RL, and M. C. Hughes, BHI, "Approval for the Stabilization of the Hexone Storage and Treatment Facility," CCN 095038, dated December 18, 2001

2) BHI-01141, REDOX Facility Safety Analysis Report, Rev. 3, dated September 2001

3) BHI-01521, Rev B, Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks, Rev B, dated July 2001

Dear Mr. Klein:

Bechtel Hanford Inc. (BHI) has completed stabilization of the Hexone Tanks at the Reduction Oxidation (REDOX) Facility in accordance with the Washington State Department of Ecology (Ecology) approval and direction as stated in Reference 1. Hexone Tanks 276-S-141 and 276-S-142 were filled with grout and the nitrogen suppression system was shut off on March 22, 2002.

The Technical Safety Requirement (TSR) E4.8, Appendix E of Reference 2 provides the administrative requirements and basis for the nitrogen suppression system. The nitrogen suppression system minimized the potential for a deflagration within the tanks by maintaining the quantity of oxygen below the levels, which would support a deflagration. This TSR was only applicable "....until such time that flammable material have been removed or the tanks have been safely stabilized or closed." (Reference 2, Section E4.8.1) Since the tanks have been stabilized, this TSR is no longer applicable. While the elimination of this TSR is not necessary, it is recommended that it be removed to eliminate any confusion during transition of the facility to Fluor Hanford, Inc. on July 1, 2002.

BECHTEL HANFORD, INC. 3350 George Washington Way Richland, WA 99352 tel (509) 375-4640 fax (509) 375-4644

MAR 2 9 2002 097966

Your approval to eliminate the TSR E4.8 is requested on or before June 1, 2002. Please feel free to contact Mr. R. G. (Bob) Egge at 373-2774 for technical support or Mr. J. J. (Jerry) McGuire for any other assistance in this matter.

Sincerely,

J. J. Hogan for
M. C. Hughes
President

SPK:dep/cmj

Attachment: USQ Safety Evaluation, Stabilization of the Hexone Tanks

B. F. Burton (RL) N2-36, w/a
A. B. Joy (RL) A6-33, w/a
P. M. Knollmeyer (RL) A5-11, w/a
S. J. Olinger (RL) A5-54, w/a
L. D. Romine (RL) A6-33, w/a
P. J. Valcich (RL) T5-58, w/a

MAR 2 9 2002 097966

bcc:

S. L. Bond H0-15, w/o
J. W. Darby H0-18, w/o
R. G. Egge R4-03, w/o
G. L. Funnell T7-05, w/o
M. C. Hughes H0-14, w/o
N. R. Kerr R4-03, w/o
S. P. Kretzschmar R4-03, w/o
A. L. Larson, H0-18, w/o
R. D. Lichfield H0-15, w/o
T.E. Logan H0-14, w/o
J. J. McGuire R4-02, w/o
J. D. Showman T7-05, w/o
P. J. Woods R4-02, w/o
S/M&T Project Files R4-02, w/a
Document Information Services H0-09

CONCURRENCES

DATE	3/25/02	3/26/02	3/25/02	3/27/02
INITIALS	PJW PJW	RGE RGE	PJW for JJM	JWD JWD

Attachment

UNREVIEWED SAFETY QUESTION DETERMINATION FORM

REDOX, STABILIZATION OF HEXONE TANKS

DIS#: 0200W-US-N0217-02, Rev. 0

Originator: A. M. Nazarali

Documents Reviewed:

- Attachment A, *Safety Evaluation For The Stabilization Of Hexone Tanks 276-S-141 & 142*
- BHI-01521, Draft B, *Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks*

Safety Basis:

- BHI-01142, Rev. 3, *REDOX Facility Safety Analysis Report*
- CCN093582, *Approval of Annual Update of the REDOX Facility Safety Analysis Report*
- 0200W-US-N0205-02, *202-S, Deactivate Silo Freight Elevator*
- 0200W-US-N0211-02, Rev. 0, *REDOX, Deactivation of Diesel Generator*
- 0200W-US-N0213-02, Rev. 0, *REDOX, Exhaust Sampling & Monitoring*
- 0200W-US-N0216-02, Rev. 1, *REDOX, Changes To Air Infiltration*
- 0200W-US-N0218-02, Rev. 0, *REDOX, Surveillance Changes*

Description of Change:

Purpose: This USQ determination evaluates the potential impacts of the proposed stabilization of the 276-S-141 and 276-S-142 retired hexone storage tanks at the Reduction–Oxidation (REDOX) facility. Proposed stabilization of the 276-S-141 and 276-S-142 retired hexone tanks at the Reduction-Oxidation (REDOX) facility is required under the Washington State Department of Ecology (Ecology) notice of correction (NoC) citing several finding concerning operation of the tank system (Ecology 2000). Tank sampling and a subsequent engineering evaluation (BHI-01521, Draft B) recommends stabilization of tanks by void fill.

Modification: The selected stabilization consists of eliminating the void space in the tank where hexone vapor collects. The void will be filled with a grout slurry, which sets to the shape of the tank. This will inhibit hexone vaporization from the residual waste in the tank and will eliminate the potential for accumulation of vapors that could otherwise lead to a combustible hazard (BHI-01521).

Once void fill is complete, the nitrogen purge will no longer be needed for the control of the combustible hazard in the tanks. Aboveground piping and equipment may be removed, including the nitrogen supply. At a minimum the HEPA filter, and the carbon filters will be removed. Ongoing maintenance of active equipment would not be required as the system will be passively safe. There would be no need for monitoring of liquid intrusion, and the HSTF site would remain fenced. The engineering evaluation selected cement grout slurry as the void fill material.

Summary Evaluation: The USQ, 0200W-US-N0183-02, and DOE approval (CCN083509) as incorporated in the BHI-01142, Rev. 3 provides the safety controls and limitations applicable to the HSTF. The TSR (BHI-01142, Appendix E, Section E.4.8) defines the limiting oxidant levels that are required for the hexone tanks. These controls remain in affect during the duration of the grout fill operations. While no changes are required in the TSR requirements minor modification to the nitrogen supply piping will be made to ensure an adequate nitrogen supply for the void fill activities. Other programmatic controls similar to previous sampling activities are also required during the void fill. Requirements for the nitrogen purge, TSR E.4.8, will not be applicable once the hexone tanks are filled with grout. Approval to retire the TSR will be obtained from DOE separate from this USQ. Attachment A documents the safety analysis of the void fill activity.

Questions:

1. Could the proposed temporary or permanent change (or discovery) increase the probability of occurrence of an accident previously evaluated in the safety analyses?

   No __X__ **Yes** _____

   Basis: Previous analysis defines the accident of concern as a combustion event in the hexone tanks. The safety analysis in BHI-01142, Appendix A (Table A 2.2) defines the probability of occurrence of a combustion event as likelihood C, Occasional (based on 0200W-US-N0183-02). The safety analysis for the void fill operations (Attachment A) finds no new or changes that related to the probability of occurrence of a combustion accident. The void fill activities therefore, do not increase the probability of the previously analyzed accident.

2. Could the proposed temporary or permanent change (or discovery) increase the consequences of an accident previously evaluated in the safety analyses?

   No __X__ **Yes** _____

   Basis: Previously, analysis, 0200W-US-N0183-02, defines the worst case tank temperature, that which relates to the highest combustion energies, occurs with tank temperatures at approximately 75^0 F. Attachment A concludes that maximum tank temperatures may exceed those required to support hexone concentration above flammability limits. After initial grout set the waste sludge will be contained in the grout and there will be no significant addition of vapors, as the waste will be fixed in the grout. Remaining hexone vapors within the void space will be diluted by the water vapors generated by the heat of hydration of the grout. Therefore, void fill activities will not increase the postulated consequences as evaluated in the REDOX safety analysis (BHI-01142).

3. Could the proposed temporary or permanent change (or discovery) increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the safety analyses?

No __X__ Yes _____

Basis: The void fill activities do not change the system functions that are relied upon as safety controls. Potential combustion events remain controlled by TSR for nitrogen purge (BHI-01142, Section E.4.8). Ignition sources of sparking and static will be controlled as they were for previous sampling activities (0200W-US-N0183-02 and 0200W-US-N0199-02). Therefore, no increase in the probability of a malfunction of equipment that is important to safety is postulated.

4. Could the proposed temporary or permanent change (or discovery) increase the consequences of a malfunction of equipment important to safety previously evaluated in the safety analyses?

No __X___ Yes _____

Basis: Attachment A concludes that the tank vapors during the void fill will have lower combustion potential during the period of void fill than previously analyzed. Tank temperatures will be less then that required for optimal combustion with the initial lift and set, and the water vapor given off during the void fill reduces the potential for combustion. The worst case combustion event therefore, would not increase the consequences of a malfunction of equipment that is important to safety.

5. Could the proposed temporary or permanent change (or discovery) create the possibility of an accident of a different type than any previously evaluated in the safety analyses?

No __X___ Yes _____

Basis: Hazard and accident types defined in Attachment A remain the same as those previously evaluated in the safety analysis. Industrial worker hazards dominate the hazard spectrum of the void fill activities. Potential release events include spill hazards and the bounding combustion accident that were previously analyzed. As these are the same types of hazards and accidents that were previously analyzed, no accidents of a different type are anticipated from those previously evaluated.

6. Could the proposed temporary or permanent change (or discovery) create the possibility of a malfunction of equipment important to safety of a different type than any previously evaluated in the safety analyses?

No __X___ Yes _____

Basis: The primary components that prevent the applicable accident (i.e., the combustion event) are those of the nitrogen purge system. Physical change is limited to the modification to the tubing that supplies nitrogen to each tank. The tubing modification will deliver nitrogen to the top of each tank to permit a continuous purge during the void fill operations. Other components that are relied upon to supply the nitrogen may change to maintain the required purge however required safety margin will remain. The potential impacts of the void fill activities such as potential impacts from other equipment (e.g., grout transfer equipment) remain the same as previously evaluated in 0200W-US-N0183-02 and 0200W-US-N0199-02. The planned void fill activities consequently, will not introduce a malfunction of a different type because no new failure mechanisms have been introduced.

7. Does the proposed temporary or permanent change (or discovery) reduce the margin of safety as defined in the basis for any technical safety requirement?

No __X___ Yes _____

Basis: The applicable TSR, Section E.4.8 of BHI-01142, defines a safety margin for the oxygen concentration for the tank vapor space. The limiting oxidant concentration derived under NFPA 69 requires that oxygen concentrations be maintained $\leq$ 11%. Operational limits provide for the maintenance of level $\leq$ 6.6% for a system that is not continuously monitored. Calculations and sampling provides a confident basis that oxygen concentrations are currently less then 2 % in the void space of the tanks. Evaluation in Appendix A demonstrates a reasonable margin of safety with oxygen concentrations up to 4.5%. The continued operation of the nitrogen purge during the void fill, will maintain the margin of safety provided in the TSR.

UNREVIEWED SAFETY QUESTION DETERMINATION FORM

REDOX, STABILIZATION OF HEXONE TANKS

DIS#: 0200W-US-N0217-02, Rev. 0

DES Concurrence Required (indicate)? ~~Yes~~/No

Design Engineering Specialist (DES) approval required for positive safety evaluations that indicate change or discovery is an unreviewed safety question

If "YES," then DES signature required.

DES -N.A.- **Date:** ____________
Insert Name as applicable

DOE Approval Required **Yes** ___ **No** _X_ **Reference:** -N.A.-

USQ Evaluator 1 Stuart Kretzschmar **Date:** 2/6/02
S. P. Kretzschmar

USQ Evaluator 2 N R Kerr **Date:** 2/06/02
N. R. Kerr

Redline markup of affected pages attached? **No** _____ **Yes** __X__

See Attachment B

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UNREVIEWED SAFETY QUESTION DETERMINATION FORM

REDOX, STABILIZATION OF HEXONE TANKS

DIS#: 0200W-US-N0217-02, Rev. 0

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SAFETY EVALUATION FOR THE STABILIZATION OF HEXONE TANKS 276-S-141 & 142

A. M. Nazarali
S/M&T Project
December 2001

This safety evaluation analyzes the proposed stabilization of the 276-S-141 and 276-S-142 retired hexone storage tanks at the Reduction–Oxidation (REDOX) facility. Previous USQs and appended safety evaluations (0200W-US-N0144-02, 0200W-US-N0183-02 and 0200-US-N0199-02) define the necessary requirements to safely maintain the inactive storage tanks. In May 2000, Washington State Department of Ecology (Ecology) issued a notice of correction (NoC) citing several findings concerning operation of the tank system (Ecology 2000). Tank sampling and a subsequent engineering evaluation BHI-01521, Draft B, recommends stabilization of the tanks by void fill. The evaluation is prepared to support the required USQ determination and documents the impacts to the documented safety analysis that is contained within the *REDOX Safety Analysis Report*, BHI-01142, Rev.3.

Documents Reviewed

REDOX Facility Safety Analysis Report, BHI-01142, Rev. 3

0200W-US-N0144-02, Rev. 1, *REDOX Hexone Tanks*

0200W-US-N0183-02, Rev. 0, *REDOX Safety Evaluation Update*

CCN083509, *Approval To Close Hexone Unreviewed Safety Question (USQ)*

0200W-US-N0199-02, Rev. 0, *REDOX, Hexone Tank Sampling*

Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks, BHI-01521, Draft B

Design Basis for the Nitrogen System of the Hexone Tanks, 0200W-DB-G003, Rev. 1.

Hanford Site Climatological Data, PNNL-13117

Purpose/Objectives

Currently, the Hexone Storage and Treatment Facility (HSTF) is an inactive facility. A nitrogen purge maintains oxygen concentrations within the 276-S-141 and 276-S-142 tanks, below safety oxidant levels (11% oxygen). The purge is required because residual waste will generate hexone vapors above the Lower Flammability Levels (LFLs) when temperatures permit. Modifications to the HSTF are necessary to provide the stabilization required to deactivate the nitrogen purge system and reduce cost of surveillance and maintenance of the HSTF.

Modifications to facilities that are controlled under Department of Energy (DOE) nuclear safety analysis requirements require an evaluation under the Unreviewed Safety Questions process. This evaluation provides the required safety analysis of the proposed changes in support of the USQ determination. Objectives include:

- Evaluate the hazards relative to the proposed modification and void fill activities with emphasis on the exposure to hazardous substances.

- Define the facility safety requirements and related work control requirements for the modifications and void fill work scope.

Background

During the operational years (1951 to 1967) of the REDOX facility, tanks 276-S-141 and 276-S-142, stored hexone for REDOX operations. In 1989-1990, the tanks were emptied of most liquid, but sludge from the hexone removal process and a small heel of liquid remained in the tanks. After the removal, the nitrogen purge was retained to inert the tanks vapor space.

Sampling of the tank's vapor space was conducted by BHI in April of 1999 to determine if any significant volatile organic remains in the tanks. Sampling confirmed the presence of hexone and thus verified the requirement to maintain the nitrogen purge to the tanks vapor space (0200W-US-N0144-02). Tank and soil temperature monitoring, taken in October of 1999, was used to refine the safety requirements for the HSTF and operational safety margins of the nitrogen purge (0200W-US-N0183-02).

Ecology issued a NOC against the HSTF (May 31, 2000) which resulted in the transmittal of an action plan and schedule (June 26, 2000). The plan implemented sampling of the 276-S-141 and 276-S-142 tanks as a basis for an engineering study to define the best option for stabilization of the tanks and for evaluating interim and closure alternatives (0200W-US-N0199-02).

July 2001 BHI submitted an engineering evaluation for the stabilization of the 276-S-141 and 276-S-142 hexone tanks. The engineering recommendation and subsequent reviews by Ecology concludes that the tanks shall be void filled and thus eliminate the need for the nitrogen purge and continued S&M of the tanks. Once the void fill is complete, no additional surveillance or maintenance activities are anticipated except for periodic waste site surveillance (i.e., housekeeping, verification of the protective fencing and associated postings).

Facility Description

The HSTF site is located in an area northwest of the REDOX facility and is in the proximity of the 233-S building, the Plutonium Concentration Facility, which is undergoing decontamination and decommissioning (D&D). Figure 1 provides a plan view of the HSTF depicting the locations of REDOX and the 233-S facility.

The tanks are buried each having approximately 0.5 to 3 feet (~0.15-0.9 meter) of earth cover over the tops of the tanks. A chain link fence surrounds the tank area. The surface area is nearly level and is of a sand and gravel mix. One locked gate provides access into the tank area.

The two tanks are single wall carbon steel with a nominal capacity of 23,575 gallons (~89,240 liters) each. The tank shells are 28 feet (~8.5 meters) in length and 11.5 feet (~3.5 meters) in diameter with dished heads welded onto the shell ends. Tanks walls were fabricated of 3/8 inch (~0.95 cm) thick walls. Video survey of the tanks' internals records no visual evidence of leakage. There are four risers into each tank. At one end is a 24 inch (~ 61 cm) diameter manway. The manway cover is fitted with 4 inch (~ 10 centimeters) and 1 inch (2.54 cm) risers. At the other end are a 1/8 inch (0.32 cm) diameter, a 3 inch (~7.6 cm) diameter and a 4 inch diameter riser. There is also a 2-inch (5.1 cm) fill pipe and 2-½ (6.35 cm) suction pipe, which are abandoned below grade. Figure 2 provides a conceptual diagram of the tanks and piping.

The manways are below the general surface level. Past operations had excavated the manways for access during the sampling operations (2001). Piping that was needed for the hexone removal, was installed through the flange over the manways on the tanks. The manways were modified in 2001 with the incorporation of a valved 4-inch riser as an aid for inspection and a 1-inch riser for possible future nitrogen purge. Supply piping ($1/8^{th}$ inch) for the nitrogen purge enters the tanks. The 3 inch risers on the 276-S-141 and the 276-S-142 tank are connected to flame arresters (on each discharge line), a high efficiency particulate air (HEPA) filter (on a common line) then to two (in parallel) activated charcoal canisters to treat the purge gas prior to release. The 4 inch risers of each tank are fitted with sampling equipment that remains from the BHI vapor space sampling. The sampling equipment includes vapor extraction tubing and connections for temperature and oxygen readings.

Figure 1. Plan view of the Hexone Storage Tank Facility depicting the locations of REDOX and the 233-S facility

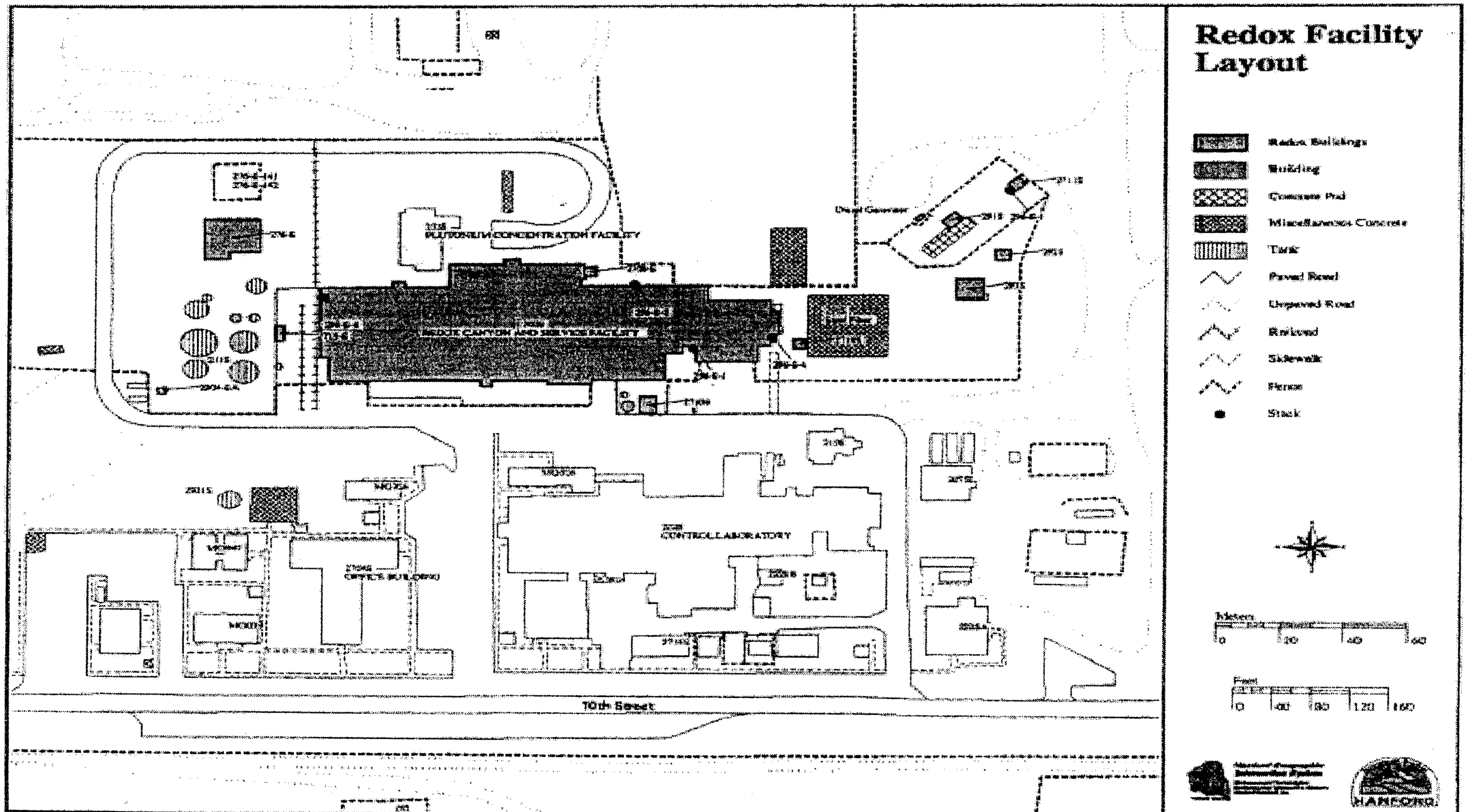
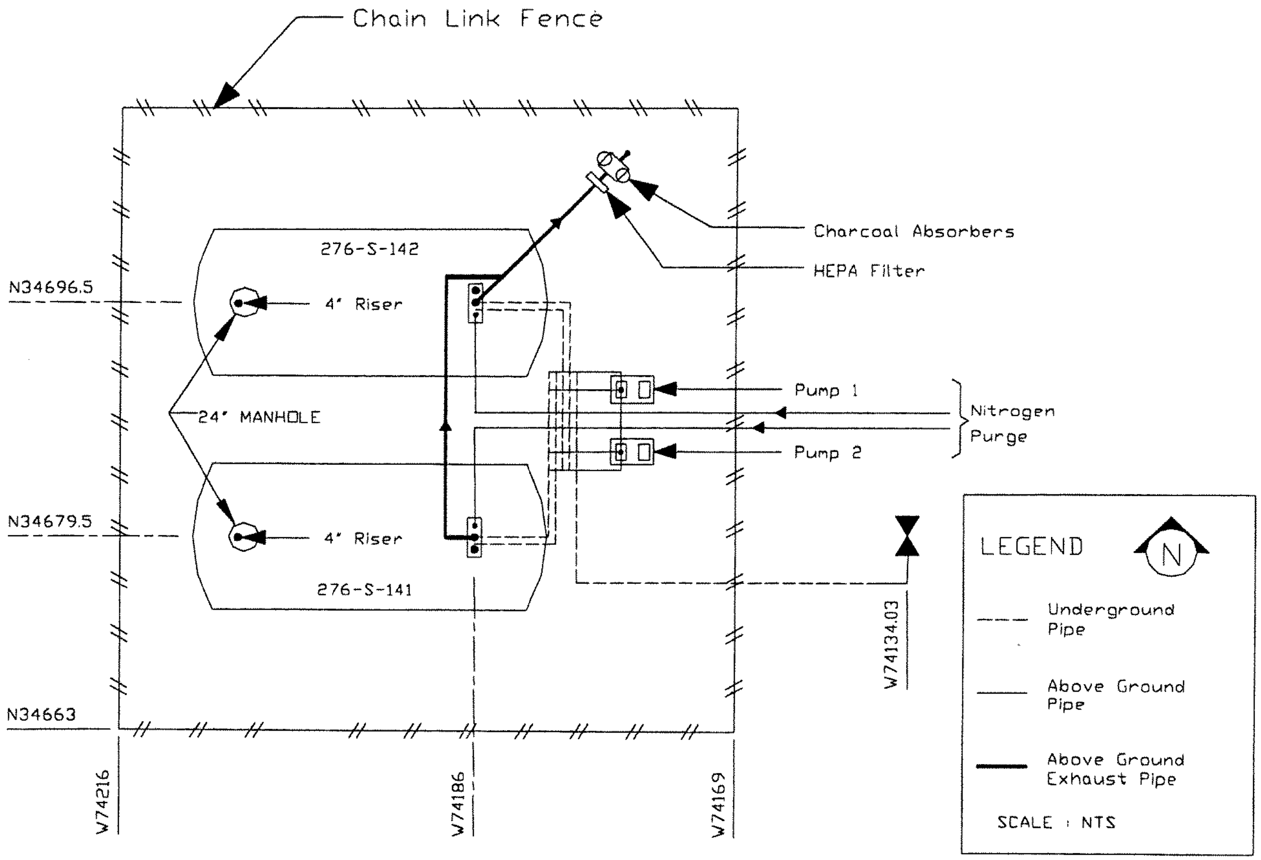


FIGURE 2. CONCEPTUAL DIAGRAM OF THE HEXONE TANKS AND PIPING



Proposed Work Scope

The selected stabilization consists of eliminating the void space in the tank where vapor collects. Stabilization is planned between the months of February and April 2002. The void will be filled with a suitable grout slurry, which sets to the shape of the tank. This will inhibit hexone vaporization from the residual waste in the tank and will eliminate the potential for accumulation of vapors that could otherwise lead to a combustible hazard (BHI-01521).

Once void fill is complete, the purge system will no longer be needed. Above ground piping and equipment may be removed, including the nitrogen supply. As a minimum the HEPA filter, and the carbon canisters will be removed. Ongoing operation and maintenance of equipment would not be required, as the system will be passively safe. There would be no need for monitoring of liquid intrusion, and the HSTF site would remain fenced. The engineering evaluation selected cement grout slurry as the void fill material. The level of chemical reactivity with the residual waste material is not a concern.

Work activities considered in this evaluation include the following:

- Mobilize to the site.
- Place grout into the tanks.
- Modify system/remove piping and components as necessary.
- Demobilize personnel and equipment.

Site Mobilization

Mobilization for the void fill project includes the removal of the vapor sample trees that were previously installed in the 4-inch diameter risers of each tank. A transparent plastic sleeve will be attached over the 4-inch riser as a viewing aid during void fill. A riser will also be modified at the manway 4-inch riser to accommodate grout placement. The nitrogen supply tubing will be routed to the manway 1-inch riser to enable the nitrogen purge to be introduced at the tank top instead of tank bottom. Control components may be modified if necessary to maintain flows to maintain oxygen concentrations required (BHI-01142, Rev. 3, E.4.8). Minor excavation may be required around the manway to accommodate modifications to the risers.

Grout Placement

The slurry will be pumped into each tank through the 4-inch riser at the manway. The grout will be fed into the tanks in repetitive lifts allowing the slurry to take an initial set prior to subsequent placements. Placement will utilize delivery trucks and pump that are staged outside of the exclusion fence that surrounds the hexone tanks. A transfer hose that extends through the fence and connects to the 4-inch riser will be used to place the slurry. The inert gas displaced by the slurry placement will exhaust through the existing treatment components (i.e., HEPA filter and carbon canisters). The mix design is a moderate strength high slump pumpable grout with fly ash cement and sand materials with an approximate 43% water/grout ratio and 0.5% to 2.0% entrained air. The grout pumping system will be controlled to minimize potential pressure to tank fitting (<100 psi).

System Modifications

The tank vapor treatment equipment (i.e., HEPA filter and charcoal canisters) will be removed once void fill is complete. The nitrogen purge system (i.e., nitrogen bottles, controls, instrumentation and piping) may be removed. Equipment that is removed will be prepped for disposal compliant with applicable waste management requirements or recycled for reuse. Tank openings will be inspected (i.e., tank risers or appended connections) for tightness and will be sealed or closed to minimize potential leakage between the tank interiors to the environment.

Demobilization

Demobilization will consist of removing temporary power or other utilities. Temporary support such as placement and confinement aids will be removed and disposed compliant to regulatory and contractual requirements. The area will be inspected to ensure the fence; gates, signs and postings are secured, replace or updated as required.

Hazard Identification

Hazard associated with the selected alternative (Void Fill) that were identified in BHI-01521, Draft B. Hazards identified in BHI-01521 are limited to actions within the tank and not related to the entire work scope. Several criteria considered in selecting fills material in BHI 01521are listed in the following.

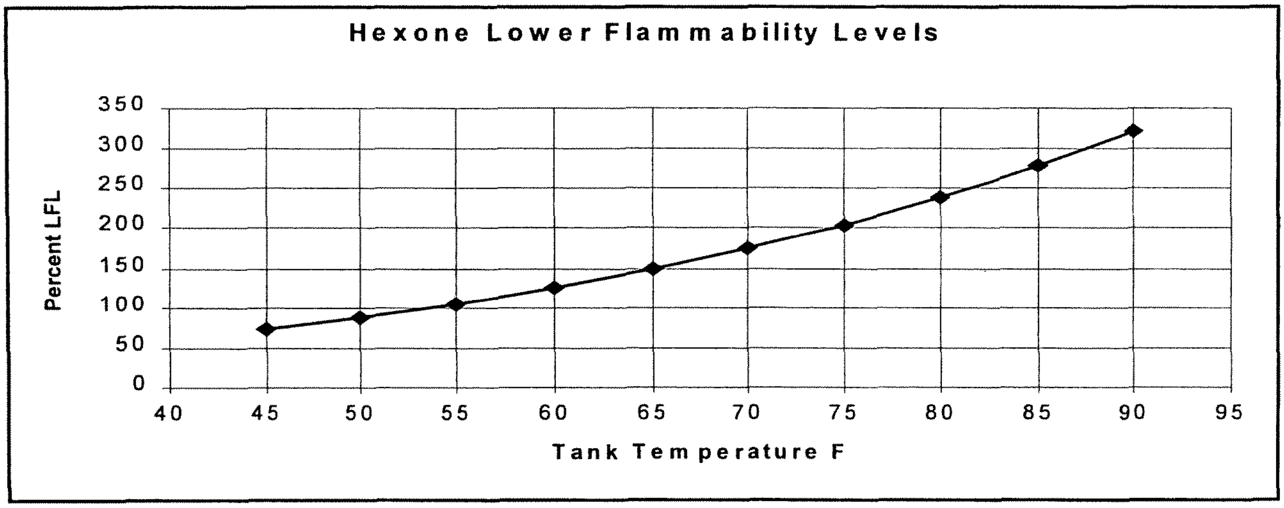
- Chemically nonreactive with the residual waste material
- Commercially available
- Provide long-term stability
- Easily placed (self-leveling).

Industrial hazards that have no potential for release of radiological or hazardous material are not subject of this analysis. Industrial hazards are evaluated in a work specific job hazard analysis.

Safety evaluation for sampling the hexone tanks, 276-S-141 and 276-S-142 (0200W-US-N0183-02, Rev.0) has analyzed the deflagration hazard. Consistent with the REDOX SAR (BHI-01142), the site worker is assumed at 30 meters from the tank. The calculated dose was approximately 2.8 rem committed effective dose equivalents (CEDE). The dose to co-located worker located at 100 meters was about 350 mrem CEDE. The total integrated dose to the public at 5.2 km from a puff release was 0.6 mrem CEDE.

Tank temperature has been previously evaluated (0200W-US-N0183-02) and found to be approximately 2°F higher than 3-ft deep soil temperature. Applicable soil temperature data for the 200 Area indicates that monthly soil temperatures at 3 feet range from 34 °F to 84 °F (0200W-US-N0199-02). The average temperatures at 3 feet are ~42 °F for February and ~46 °F for March. The highest monthly average soil temperatures for soil at 3 feet are 47°F for February and 52°F for March (PNNL-12087). As the tank temperature is expected to approximate the three foot soil temperatures plus 2^{0}F (49^{0}F to 54^{0}F), hexone vapor concentration may be greater then the 1.2% defining the LFL (~101% of LFL at 54°F). Figure 3 presents the Hexone tank lower flammability levels (LFL) as the function of tank temperature.

Figure 3. Hexone tanks percent LFL as function of tank temperature



Tank temperatures are expected to be below that required to support LFL concentrations of hexone as the initial grout installations are expected to occur in February. Only if the installations are delayed into March and the ground temperatures are above average would tank temperatures support hexone vapor concentrations equal to or greater than the LFL.

Grout Pumping Failure

During injection of the grout into the hexone tanks there is the possibility of mechanical stress on the riser of the tank. This stress will be minimized by use of supports from the pumper truck and the pump pressure control. Should separation occur, it would create an opening that could allow the release of the tank vapor. The separation of the riser from the tank would release a very small amount of the tank vapor which, could provide a minor release potential. As this type of release has been previously evaluated and the appropriate controls identified (BHI-01142, Rev. 3, Appendix A , Table A-2), no further evaluation is required.

Entrained Air

During grouting process the nitrogen purge will be continued. The nitrogen purge as previously evaluated maintains the oxygen concentration in the tanks <6.6% per section E4.8. During grouting the percent of oxygen may increase as the grout volume within the tanks increases. This is due to the small amount of entrained air in the grout material. The grouting material contains approximately 0.5% to 2.0% entrained air. Fractions of the entrained air could be released during placement and thus become a source of oxygen in the tank. The potential increase in oxygen concentrations due to the proposed grout installation is evaluated in the hazard analysis.

Exhaust Filter (Charcoal Canister) Blockage

Installation of grout place will increase water vapor and could increase particulate in the tank void space. If forced downstream towards the HEPA filter and charcoal canisters, then their treatment performance will be impacted. The blockage of these component may cause the displaced air in tanks to exit through untreated openings (i.e., the 4 inch riser where the sample tree was removed and the viewing port is install). A breach could result in an unwanted exposure to workers. The exposure potential would be similar to those previously analyses for sampling and are categorized as negligible to minor exposure potential. Personnel protection will be provided as required by industrial hygiene requirements implemented under the BHI Safety and Health program. Additional protection for the filter and charcoal canister or other contingent actions will be provided as necessary to meet regulatory air requirements and good engineering practices.

Heat of Hydration

The grout mix can be assumed to have a temperature of approximately 65^0F when pumped into the tanks. The additional heat of hydration of the grout theoretically would drive the tank temperature upward thereby providing an environment for greater evaporation potential. Based on the tank temperature discussion above, a small temperature rise of 5^0F above the highest predicted temperature for February could theoretically support LFL concentrations. Review by the engineering staff concludes that depending on the final mix design of the grout that heat of hydration could increase the area of the waste from 5^0F to 30^0F during the initial set of the grout.

The first installation of grout will be approximately 10 yd^3 (2020gallons). The thermal contribution of this amount is relatively small for first lift. The waste will be covered by this first lift to a depth of approximately 20 inches. This layer of grout is likely to have minor impact on the waste when considering the rate of heat exchange and the rate of vaporization. Though grout temperatures will increase with cure and the remaining increment lifts, there will be no substantive vaporization after the sludge is encapsulated within the initial installation and set. The initial set is anticipated to take place between 24 and 48 hours. The remaining grout will placed in lifts of approximately 1 meter or less. The installations will be placed compliant with supplier recommendations that are approved by BHI engineering. The incremental placement is controlled to minimize vaporization of the water in the grout due to excessive temperatures.

The TSR controls (BHI-01142, Section E.4.8) remain in affect until void fill is completed in each tank (See Applicability, E.4.8). No further analysis is required.

Grout/Waste Mixture

There are approximately 132 gallons of waste in form of a gel like phosphate tar at the bottom of each tank. Incremental input of grout into the tank will displace the waste. Based on grout selection criteria, the grout material will not react or mix with the waste to produce a homogenous mixture. The grout and waste formation would be in heterogeneous form and there is a possibility that small pockets of waste encapsulated within the slug and some of the waste may push upwards. However it is anticipated that the significant volume will be fixed within the initial set. However, even if portions don't set on the initial lift, the portions will set in the subsequent lifts. No waste is anticipated to be displaced external to the hexone tanks.

Tank Rupture

Hexone tanks were installed in 1951. Based on sampling and inspection, some ferrous material has been detected in sampling activities. However, the general tank integrity appears to be intact (based on video inspection) with no evidence of severe deterioration. The presence of ferrous materials indicates some oxidation and corrosion that may have taken place during the lifetime of the structure. During grouting the pressure of the massive amounts of grout is consistent with the weight generated by the fluid during operation of the tanks. However, it may rupture a weak point or portion of the tank, which is not visually evident. This event may release small amounts of waste to surrounding soil. The consequence for release is very small based on the amount of waste available for release. The tank rupture could take place based on the mass of grout placed into the tank. At the initial stage of grouting a possibility of rupture is very small and the majority of the waste will be encapsulated. At the later stage of grouting when the mass within the tank increases and possibility of rupture increases the amount of waste is minimal or non existent due to incremental grouting. As a tank leak/spill event has been evaluated in the REDOX SAR (BHI-01142, Rev.3, Appendix A), no additional analysis or controls are required.

Hazard Analysis

Entrained Air

Based on grout mix design, the air concentration within the grout would not release greater than 2.0% air to the tank void space volume if all entrained air were free for release. However, only a fraction of the entrained air would be released. For purpose of this analysis it is assumed that 1.5% entrained air of a 2% mix is free for release. The grout installation will be completed in several incremental steps. First installation will pump approximately 10 yd (2020 gallons) of grout. The remaining of the tank volume (20000 gallons) will be filled with the grout material in incremental steps as described earlier in this evaluation.

Currently the concentration of oxygen with the void space is less than 2%. The grout material is calculated to contain approximately 1.5% of entrained air consisting of ~20% oxygen. This will results in a total of 0.3% oxygen entrained within the grout material.

After the first installation and prior to later installation the amount of oxygen within the void space in the tank is conservatively calculated using the following relation. (assuming no sustained nitrogen purge).

$$\% O_2 = [(0.003)(V_g) + (0.02)(V_v - V_g)] * 100 / (V_v - V_g + .015V_g)$$

Where:

V_v is the void volume space prior to first installation = 23325 gallons = 160 yd^3
V_g is the first installation of grout volume = 2020 gallons = 10 yd^3

Therefore, for the first installation case (2020 gallons) when the initial concentration of oxygen in the tanks is 2%, the equilibrium concentration of oxygen will be 2% as shown in the following relation.

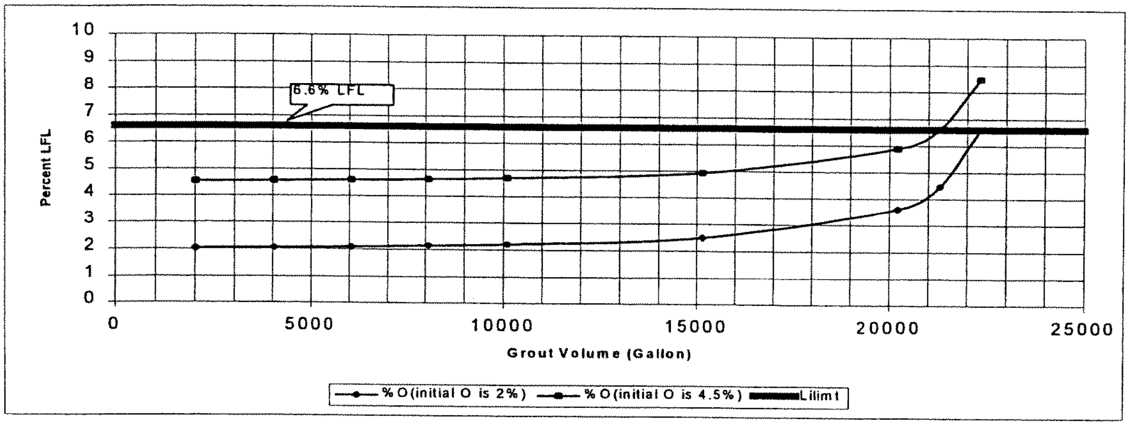
$$\% O_2 = [(0.003)(2020) + 0.02(23325\text{-}2020)] *100/[(23325\text{-}2020 +30)] = 2.0\%$$

Table 1 present the percent LFL of oxygen for initial concentration of 2% and 4.5% for several grout and void volume. The maximum grout volume before the hexone concentration exceeds 6.6% for the case of initial oxygen concentration of 2%and 4.5 % are 22350 gallons and 21300 gallons, respectively. Figure 4 show the plot of data presented in Table 1. The horizontal solid line represent the operational limits of oxygen concentration of 6.6%.

Table 1. Percent LFL of Oxygen for different Grout Volume and Initial Oxygen concentration

Grout Volume (Gallons)	2020	4040	6060	8080	10100	15150	20200	21300	22350
Void Volume (Gallons)	21305	19285	17265	15245	13245	8175	3125	2025	975
Initial Oxygen of 2%	2.02	2.05	2.09	2.14	2.2	2.5	3.6	4.5	6.6
Initial Oxygen of 4.5%	4.5	4.5	4.6	4.6	4.7	4.9	5.9	6.6	8.5

Figure 4. Percent Oxygen LFL as Function of Grout Volume



At some point towards the final lift of grout, oxygen concentrations are likely to increase. Engineering will define the necessary flow requirements to maintain the operational safety limit of 6.6% (the required safety margin of the TSR E.4.8).

Conclusion

If the nitrogen purge is not sustained, it is theoretically possible to exceed the operation limit of 6.6 % in the grout operations. Other mitigating features such as additional water vapor from the grout slurry, hexone waste fixed in initial set, and displacement of mass of hexone vapor by grout placement tend to lessen the combustion potential. However, best management practice and and the applicable TSR (E.4.8) requires the continuation of the nitrogen purge to maintain the operational limits. Modification to the nitrogen supply system and engineering guidance will be provided as necessary to ensure that the oxygen concentrations are managed as required until the grout installation is complete in each tank.

The following commitments are provided to ensure that a safe defense in depth is maintained during the purge vent modifications and void fill activities.

- Tank oxygen levels will be verified prior to initial grout placement to confirm the applicable design basis (0200W-DB-G003, Rev. 1). Upon confirmation that oxygen concentrations are $\leq$4.5%, grout placement may commence.

- Work procedures and training will implement appropriate recovery requirements should the nitrogen purge be compromised during void fill activities.

Other defense-in-depth and programmatic safety commitments that are required by the safety authorization basis include:

- Access control will ensure that only necessary and qualified personnel enter the work area.

- Open flames and ignition sources are prohibited within the HSTF site. (0200W-US-N0183-02 and CCN083509).

  No open flames are permitted within the fenced area. Only necessary equipment will be allowed into the work area. Periodic sampling (volatile organic vapors) may be taken in the work area to verify that the work area is safe as determined by BHI Safety and Health personnel.

- Components attached to the tank and electrical equipment in the proximity of potential tank opening will be bonded and grounded compliant with NFPA 77. It is noted that a commitment of the BHI Safety and Health program for a hot work permit is established by BHI fire protection. As the work scope does not require open flames or abrasive cutting of process equipment within the HSTF, a hot work permit is not required.

- Void fill activities will be coordinated with the staff of the 233-S Decontamination and Decommissioning (D&D) project to ensure that planned work and potential contingency actions are safely managed by both projects (D&D and S/M&T).

Field Support and industrial hygiene will review and establish air monitoring, if required, in the work area to ensure that appropriate air quality requirements are maintained.

- Containment (e.g., sleeving) will provide temporary barriers during the removal of the sample tree or similar tasks with the potential to release tank gases.

- Mobilization and grouting work will be limited to relatively stable weather conditions. Weather forecasts will be consulted each day and conditions will be observed to ensure that work proceeds with little risk of severe winds. Decisions regarding the start or continuation of work because of wind (or other potential environmental conditions) are provided by the field superintendent and the site safety officer.

CONCURRENCE

S/M&T Project Engineer Stuart Kripto for R.G. Egge Date 2/6/02

CHANGES TO BHI-01142, Rev. 3
REDOX FACILITIY SAFETY ANLAYSIS REPORT

The following outlines the changes to BHI-01142, Rev. 3. These changes will be incorporated into BHI-01142 in the applicable annual update following closeout of the stabilization of the hexone tanks (276-S-141 and 276-S-142).

1. Executive Summary, Section E. 7: Update the revision statement to include the interim closure of the 276-S-141 and 276-S-142 hexone storage tanks and elimination of the associated TSR for nitrogen purge of the hexone tanks.

2. Section 2.9.3: Replace the last two paragraphs with the following.

   Two hexone storage tanks, 241-S-141 and 241-S-142, each having a capacity of approximately 24,000 gallons were placed into a passively safe condition in March 2002. The tanks were filled with grout to mitigate the accumulation of hexone vapors and their inherit combustion characteristic (BHI-2002x). Approximately 130 gallons of residual wastes (BHI-2001x) remain in the bottom within the bottom of each tank.

3. Section 3.3.2.3.3, subsection Deflagration, page 3-18: Delete the section in its entirety.

4. Section 3.3.2.3.5: Delete the last paragraph.

5. Table 3-4, 276-S hexone tanks: In the column, *Included in Hazard Evaluation*, change "Yes" to "No". In the column, *Basis for Yes/No*, replace the statement with the following.

   Small quantities of radioactivity remain (BHI-1999d) within a grout matrix.

6. Table 3-6: Delete the table in its entirety.

7. Section 4.5.1: Delete the last bullet in its entirety.

8. Section 4.5.2: Add an addition bullet as follows.

   - *276-S Hexone Storage Tanks*

9. Section 5.5.7: Delete the section in its entirety.

10. Chapter 18.0, page 18-3: Add a reference as follows:

BHI-2001x, "Evaluation of Alternatives for the Interim Stabilization of the Hexone Tanks", BHI-01531, Draft B, Bechtel Hanford, Inc. Richland, Washington

BHI, 2002x, USQ Determination, "REDOX, Hexone Tank Stabilization", 0200W-US-N0217-02, Rev. 0, Bechtel Hanford, Inc., Richland, Washington

11. Table A.2-1, line, page A-8, *276-S hexone tanks*: In the column *Quantity*, revise as follows.

    Approximately 130 gal of distillation sludge

    In the column *Remarks*, replace the text with the following.

    The remaining contamination is fixed in a grout matrix.

    In the column *References,* replace the text with, *BHI-2001x* and *BHI-2002x*

12. Table A.2-1, line, page A-11, *276-S hexone tanks*: In the column *Quantity*, revise as follows.

    Approximately 130 gal of distillation sludge

    In the column *References,* replace the text with, *BHI-2001x* and *BHI-2002x*

13. Table A.2-2, line 30a.: Delete the line in its entirety.

14. Appendix D, Section D.6.4: Delete this Section in its entirety.

15. Appendix D, Section D-9: Delete the reference "BHI 2000" in its entirety.

16. Appendix E, Section E.4.5 and applicable subsections: Delete the Section and subsections in their entirety.